



THE UNIVERSITY *of* EDINBURGH

Edinburgh Research Explorer

“Isaac Newton: ciencia y religión en la unidad de su pensamiento”

Citation for published version:

Henry, J 2008, “Isaac Newton: ciencia y religión en la unidad de su pensamiento”, *Estudios de Filosofía*, vol. 38, pp. 69-101.

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

Estudios de Filosofía

Publisher Rights Statement:

With permission © Henry, J. (2008). “Isaac Newton: ciencia y religión en la unidad de su pensamiento”. *Estudios de Filosofía*, 38, 69-101

General rights

Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact openaccess@ed.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.



Isaac Newton: Science and Religion in the Unity of His Thought

[Original English version which appeared, translated into Spanish, as: “Isaac Newton: ciencia y religión en la unidad de su pensamiento”, *Estudios de Filosofía*, 38 (2008), pp. 69-101.]

Introduction

The essential unity of Newton’s thought is not a new idea—it has already been emphasised by a number of scholars; most notably by the late Betty Jo Dobbs and by James E. Force, both students of one of the doyens of Newtonian studies, R. S. Westfall, who also tended to present Newton’s life work in this way.¹ This work still has not had the impact that it deserves, however (there was no hint of the unity of Newton’s thought in the recent *Cambridge Companion to Newton* (2002), for example), and one leading Newtonian scholar has recently taken the opposite view, arguing that Newton “compartmentalized” his thought, dealing with different areas independently of one another.² What I want to do here is to try to present a comprehensive and synoptic view of the unity of Newton’s thought.

¹ Betty Jo Teeter Dobbs, *The Janus Faces of Genius: The Role of Alchemy in Newton’s Thought* (Cambridge: Cambridge University Press, 1991); James E. Force, “Newton’s God of Dominion: The Unity of Newton’s Theological, Scientific, and Political Thought”, in J. E. Force and Richard H. Popkin, *Essays on the Context, Nature, and Influence of Isaac Newton’s Theology* (Dordrecht: Kluwer Academic, 1990), pp. 75-102; Stephen Snobelen, “To Discourse of God: Isaac Newton’s Heterodox Theology and His Natural Philosophy”, in Paul B. Wood (ed.), *Science and Dissent in England, 1688-1945* (Aldershot, Hampshire: Ashgate, 2004), pp. 39-65.

² I. B. Cohen and George E. Smith (eds), *The Cambridge Companion to Newton* (Cambridge: Cambridge University Press, 2002); Rob Iliffe, “Abstract considerations: Disciplines, Audiences and the Incoherence of Newton’s Natural Philosophy”, *Studies in History and Philosophy of Science*, 35 (2004): 427-54. It is perhaps worth noting that Iliffe’s point is that Newton always adheres to the disciplinary conventions and procedures of any given discipline that he is working in, and does not investigate inappropriate questions as he works in any one discipline. So, he does not address natural philosophical concerns when working on mathematics, for example, or alchemical concerns when conducting historical research. This is for the most part true, but does not affect the argument in this paper. Besides, there is evidence that Newton *did* try to mix the conventions of one discipline with another; see, Raquel Delgado-Moreira, “Newton’s Treatise on Revelation: The Use of a Mathematical Discourse”, *Historical Research*, 79 (2006): 224-46.

One of the major reasons for the success of Newton's natural philosophy was its role in developing an authoritative natural theology. The use of studies of the natural world to prove the wisdom, omnipotence and benevolence of the Creator flourished in seventeenth-century England and Newton's works were quickly embraced by natural theologians. Furthermore, Newton himself brought out the theological implications of his own natural philosophy. Although there is no hint of God in the first edition of the *Principia*, for the second edition (1713) Newton introduced a "General Scholium" in which he explicitly discussed the relationship between God and His creation.

Completing his discussion, he wrote: "This concludes the discussion of God, and to treat of God from phenomena is certainly a part of natural philosophy."³ But long before this, in his unpublished writings, we can see evidence of Newton's conviction that his natural philosophy depends upon, and therefore reveals, the fact that the world was created by "a voluntary Agent" who is "very well skilled in mechanics and geometry."⁴ In spite of his silence about God in the first edition of the *Principia*, therefore, we have absolutely no reason to doubt the truth of Newton's claim to Richard Bentley, in 1692, that

³ Isaac Newton, *The Principia: Mathematical Principles of Natural Philosophy*, translated by I. B. Cohen and Anne Whitman (Berkeley, Los Angeles and London: University of California Press, 1999), p. 943. The full text of the "General Scholium" appears pp. 939–44. This important addition to the *Principia* has attracted a number of separate studies: Larry Stewart, "Seeing through the Scholium: Religion and Reading Newton in the Eighteenth Century", *History of Science*, 34 (1996): 123–65; Stephen Snobelen, "'God of Gods, and Lord of Lords': The Theology of Isaac Newton's General Scholium to the Principia", *Osiris*, 16 (2001): 169–208; and Steffen Ducheyne, "The General Scholium: Some Notes on Newton's Published and Unpublished Endeavours", *Lias: Sources and Documents Relating to the Early Modern History of Ideas*, vol. 2, 2006, 47 pp.

⁴ Isaac Newton, *Four Letters from Sir Isaac Newton to Doctor Bentley. Containing Some Arguments in Proof of a Deity* (London, 1756), pp. 3, 8. Reprinted in I. B. Cohen (ed.), *Isaac Newton's Papers and Letters on Natural Philosophy* (Cambridge, Mass.: Harvard University Press, 1978), pp. 279–312, see p. 282 and 287. Henceforth cited as Newton, *Four Letters*, giving original pagination followed in parentheses by the pagination in Cohen's edition.

When I wrote my treatise about our system, I had an eye upon such principles as might work with considering men for the belief of a Deity; and nothing can rejoice me more than to find it useful for that purpose.⁵

Newton's obsession with scriptural interpretation was for a long time dismissed as an embarrassment. Its importance for a proper understanding of Newton is now acknowledged, however, and is stimulating much new activity among Newton scholars. The significance of this work now makes it easy to see the point of Richard H. Popkin's question: "why did one of the greatest anti-Trinitarian theologians of the 17th century take time off to write works on natural science, like the *Principia Mathematica*?"⁶ It is now becoming clear that the answer to this question can be found in the fact that Newton's natural philosophy was all of a piece not just with his alchemy and his natural theology but also with his efforts at scriptural exegesis. When asked once how he made his great discoveries in natural science Newton is said to have replied "by continually thinking unto them".⁷ It now seems that Newton was continually thinking about his God and the nature of Providence and that all the different aspects of his life's work should be seen as different ways of continuing to discover all he could about God and His relationship to the world. Judging from Newton's manuscript remains, it seems undeniable that he spent far more time, throughout his life, studying Scripture and other Ancient records, than he ever did on mathematics or physics. Similarly, although he is now known to have spent more time studying alchemical writings, and pursuing his own experiments in alchemy, than he

⁵ Newton, *Four Letters*, p. 1 (280).

⁶ Richard H. Popkin, "Newton's Biblical Theology and His Theological Physics", in P. B. Scheurer and B. Debrock (eds), *Newton's Scientific and Philosophical Legacy* (Dordrecht: Kluwer Academic, 1988), pp. 81-97, p. 81.

⁷ David Brewster, *Memoirs of the Life, Writings, and Discoveries of Sir Isaac Newton*, 2 vols (Edinburgh, 1855), II, p. 399.

spent on more mainstream aspects of natural philosophy, it still absorbed less of his attention than his attempts through historical and Scriptural studies to establish the true faith.

The unity of Newton's thought was first suggested by the Spanish scholar, David Castillejo, in 1981. Although the details of Castillejo's arguments proved unconvincing to most Newton experts (if not, indeed, incomprehensible—being partly based, for example, on supposed similarities between Newton's view of light rays and chemical composition on the one hand, and the structure of Solomon's Temple in Jerusalem on the other⁸), it provided the seed for a view which is now gaining consensus. The unity of Newton's thought has now been reiterated in more down to earth terms. It has been explained by James E. Force in terms of Newton's concern with a God of absolute dominion and a concomitant voluntaristic theology, and by the late Betty Jo Dobbs in terms of a natural theology in which active principles within matter are established to be secondary causes testifying to God's power and wisdom.⁹ A convincing testament to the correctness of this way of looking at Newton and his work is provided by the fact that it is easy to combine the conclusions of Force and Dobbs into one account, even though the former arrived at his ideas by studying Newton's theology, and the latter by studying Newton's alchemy.

⁸ David Castillejo, *The Expanding Force in Newton's Cosmos as Shown in His Unpublished Papers* (Madrid: Ediciones de Arte y Bibliofilia, 1981), pp. 50, 110-11, 116-7. Newton discussed the construction of the Jewish Temple in a number of manuscripts, and in the posthumously published *Chronology of Ancient Kingdoms Amended* (London, 1728). For a sympathetic, but nonetheless critical, assessment of Castillejo's book, see R. S. Westfall's review in *Annals of Science*, 39 (1982), pp. 226-7.

⁹ Force, "Newton's God of Dominion"; and Dobbs, *Janus Faces of Genius*. The major influence of this work on Newton studies has been an increased focus upon Newton's theology and religion. Where previously these areas were considered too esoteric, their broader relevance to an understanding of Newton's work is now recognised. Consider, for example, the articles in James E. Force and Richard H. Popkin (eds), *The Books of Nature and Scripture* (Dordrecht: Kluwer Academic, 1994), and idem, *Newton and Religion: Context, Nature and Influence* (Dordrecht: Kluwer Academic, 1999).

Newton's Natural Theology

Even in his very first exercise in natural philosophy, the undergraduate notebook he entitled “*Questiones quaedam Philosophicae*” (“Certain Philosophical Questions”) written between 1664 and 1665, Newton obviously considered that discussion of God certainly belonged to natural philosophy.¹⁰ In a brief but telling entry “Of God”, Newton declares that the world must have been created by divine intelligence. This leads him to an entry “Of the Creation” in which he affirms that God made matter out of nothing and then modified matter to create individual entities. He proceeds here by firstly referring to the Bible and then interpreting it in the light of reasoned argument. Similarly, in the following section, Newton uses the nature of memory, and even perception, to argue for the immaterial nature of the human soul. The presence of such articles in a notebook on natural philosophy should not be regarded as unusual. Natural philosophy had always been regarded as a handmaid to the so-called “queen of the sciences”, theology. It was generally assumed that there can be only one truth. Wherever the Scriptures mentioned natural phenomena, therefore, it was assumed that sound natural philosophy would confirm, or at least would not oppose, Biblical pronouncements.

Furthermore, as Newton was growing up and learning natural philosophy, he could hardly fail to be affected by the new and flourishing movement in English natural philosophy towards what came to be called natural theology. This was an endeavour to establish the existence and some of the major attributes of God by studying His Creation. Among the earliest works in this influential tradition were Walter

Charleton's *Darknes of Atheism dispelled by the Light of Nature* (1652), described by

¹⁰ As he made explicit in the “General Scholium” to the 2nd edition of the *Principia*, p. 943. For the full text of the notebook, and a detailed commentary, see J. E. McGuire and Martin Tamny, *Certain Philosophical Questions: Newton's Trinity Notebook* (Cambridge: Cambridge University Press, 1983).

its author as a “physico-theologicall treatise”, and Henry More’s *Antidote against Atheism* (1653). The work of both of these authors was well known to Newton, and More, being a fellow of Christ’s College and already a leading figure in Cambridge when Newton arrived as a young student, was a particular influence upon him.¹¹ It is hardly surprising, therefore, that Newton should have regarded his own natural philosophy as a means of understanding the nature of God through studying the Creation.

Natural theology plays a prominent role in one of Newton’s earliest, and most remarkable, exercises in natural philosophy. Newton’s manuscript treatise entitled *De gravitatione et aequipondio fluidorum* (“On the Gravitation and Equilibrium of Fluids”) was an early attempt, as he put it, to deal with a topic “by two methods”, mathematically and physically (or philosophically). Probably written in the late 1660s, before 1672 anyway, this fascinating work nevertheless develops ideas which Newton continued to hold and to use much later in his career.¹² Most of the treatise,

¹¹ For the influence of Charleton and More on Newton see the commentary by McGuire and Tamny in *Certain Philosophical Questions*, and J. E. McGuire, *Tradition and Innovation: Newton’s Metaphysics of Nature* (Dordrecht: Kluwer Academic, 1995). The influence of More is also discussed in Koyré, *From the Closed World to the Infinite Universe* (Baltimore: Johns Hopkins University Press, 1957), B. J. T. Dobbs, *The Foundations of Newton’s Alchemy: Or, ‘The Hunting of the Greene Lyon’* (Cambridge: Cambridge University Press, 1975), and idem, *Janus Faces of Genius*.

¹² Cambridge University Library, MS. Add. 4003. Indeed, the similarities with material in the *Principia* are so striking that the late Betty Jo Dobbs argued that it was written in 1684, as an abandoned draft for the *Principia*. Dobbs, *Janus Faces of Genius*, pp. 138-46. Dobbs provides references to earlier acknowledgements of the similarities between *De gravitatione* and the *Principia*, pp. 139-40. So far her arguments have not won consensus, although they have been sympathetically considered in J. E. McGuire, “The Fate of the Date: The Theology of Newton’s *Principia* Revisited”, in Margaret Osler (ed.), *Rethinking the Scientific Revolution* (Cambridge: Cambridge University Press, 2000), pp. 271-95. I continue to go along with the earlier dating of A. R. Hall and M. Boas Hall, *Unpublished Scientific Papers of Isaac Newton* (Cambridge: Cambridge University Press, 1962), pp. 89-90, with which R. S. Westfall and others concur, and which has been confirmed by Freidrich Steinle, *Newtons Entwurf “Über die Gravitation...”: Ein Stück Entwicklungsgeschichte seiner Mechanik* (Stuttgart: Franz Steiner Verlag, 1991), pp. 124-5. As can be seen from the present account of Newton’s life’s work, he often continued to use early ideas in his later work, particularly religious and metaphysical ideas, so the similarities do not signify proximity of composition. Moreover, it seems hard to believe that Newton would have given a definition of gravity like the one in *De gravitatione*, “Definition 10” (Hall and Hall, *Unpublished Scientific Papers*, pp. 148-9) after his correspondence with Robert Hooke in 1679 about gravity as an attractive force operating at a distance. See below, and R. S. Westfall, *Never at*

which was never completed, is concerned with a digression on the nature of space and body. Beginning with a critique of Cartesian arguments about the relative nature of motion, Newton begins to develop his own notion of absolute space which is later to become characteristic of Newtonian cosmology. Newton points to the contradiction in the Cartesian position between arguments which depend upon a tendency for bodies to recede from the centre about which they revolve (the sling-shot effect) and claims that the Earth and other planets do not move because, as part of the swirling vortex of the solar system, they remain surrounded by the same matter. According to the Cartesian definition of movement, which requires a change of place to be determined by a changing relationship to surrounding bodies, if the surrounding matter remains the same, then no change of place, or movement, can be said to have occurred.

(Descartes's principle concern here was to avoid an outright affirmation of the motion of the Earth in view of the condemnation of Copernicanism by the Roman Catholic Church). For Newton, however, the centrifugal force proved the reality of the motion, and the absolute nature of space, an argument which he was to develop in the *Principia* with his famous "thought experiment" of the rotating pail of water.¹³ The faster a pail of water rotates, the more the water will rise up the sides of the pail and assume a concave surface. The surface, Newton insisted, showed the absolute motion of the water, even though Descartes could claim the water was stationary because it was moving together with the surrounding surface of the pail.

Rest: *A Biography of Isaac Newton* (Cambridge: Cambridge University Press, 1980), pp. 382-8. For a complete study of *De gravitatione* see Steinle, *Newtons Entwurf*.

¹³ Hall and Hall, *Unpublished Scientific Papers*, pp. 124. The argument for absolute space and motion based on what is observed when a bucket of water is rotated appears in a scholium on time, space, place and motion in the introductory part of the *Principia*, before Book I. See Newton, *The Principia*, pp. 412-3. See also McGuire, "Fate of the Date", p. 279. For a full discussion of the argument and its validity see, Robert Disalle, "Newton's Philosophical Analysis of Space and Time", in Cohen and Smith (eds), *Cambridge Companion to Newton*, pp. 33-56.

It is clear, therefore, that even at this early stage Newton believed that a correct view of the nature of space was crucially important “to lay truer foundations of the mechanical sciences” than could be grounded on Cartesian notions of extension. And yet, what followed in *De gravitatione* had much more to do with God and his relationship to the world, than with the foundations of the mechanical sciences. Space is neither a substance nor an accident, Newton said, dismissing the relevance of traditional Aristotelian categories, it is “an emanent effect of God”, co-eternal with God and a necessary prerequisite for all being.

No being exists or can exist which is not related to space in some way. God is everywhere, created minds are somewhere, and body is in the space that it occupies; and whatever is neither everywhere nor anywhere does not exist.

It is not possible, Newton insists, to “think that space does not exist”.¹⁴

What is perhaps more remarkable than Newton's concept of space is the closely associated theory of body. Admitting from the outset that this notion of body is speculative, Newton nonetheless insists that it is “within the power of God”. Newton suggests that body may be nothing more than a part of space which God, by an act of will, makes impenetrable:

If he should exercise this power,... it seems impossible that we should not consider this space to be truly body from the evidence of our senses... for it will be tangible on account of its impenetrability, and visible, opaque and

¹⁴ Hall and Hall, *Unpublished Scientific Papers*, pp. 131, 132, 136, 137. The classic account of Newton's concept of space and its religious context remains Koyré, *From the Closed World*, but for a brief account see Alan Gabbey, Daniel Garber, *et al.*, “New Doctrines of Body and Its Powers, Place and Space”, in M. Ayers and D. Garber (eds), *The Cambridge History of Seventeenth-Century Philosophy*, 2 vols (Cambridge University Press, Cambridge, 1998), 1, pp. 553-623, especially pp. 602-8.

coloured on account of the reflection of light, and it will resonate when struck...¹⁵

Speculative as this is, it has a very clear advantage, Newton believes, over all other theories of body:

For we cannot postulate bodies of this kind without at the same time supposing that God exists, and has created bodies in empty space out of nothing,... Say, if you can, which of the views already well known, elucidates any one of these truths or rather is not opposed to all of them.

The Cartesian view by contrast, Newton immediately suggests, is “a path to Atheism”. Here, then, we have early confirmation of the claim by his friend, John Craig, that Newton showed “the errors of Cartes’s Philosophy... because he thought it was made on purpose to be the foundations of infidelity”.¹⁶

But the theory of space and body developed in *De gravitatione* is remarkable not just because it seeks to prove the existence of God, but also because of the kind of Providential God it depends upon. Newton was a highly committed believer in what is called voluntarist theology, which emphasises God’s omnipotence and the unrestrained freedom of his will. Time and again in Newton’s theory of body in *De gravitatione* the supreme role of God’s will is emphasised. God creates “by the sole action of thinking and willing”, for creation “an act of the divine will” is enough, God created “the world solely by the act of will”.¹⁷ Newton’s God was a God of absolute dominion over the world and its creatures.

Newton’s Scriptural Theology

¹⁵ Hall and Hall, *Unpublished Scientific Papers*, pp. 138, 139.

¹⁶ Cambridge University Library, Keynes MS 130.7, f. 1r.

¹⁷ Hall and Hall, *Unpublished Scientific Papers*, pp. 139, 140, 141.

Newton's particular conception of the nature of God is evident from a list of his sins which he drew up on Whitsunday 1662. Although some of his sins are mundane, many of those that occurred to him as he compiled his list were sins against God. Sabbath breaking was common, but it didn't stop there: "Setting my heart on money learning pleasure more than Thee"; "Not loving Thee for Thyself"; Not desiring Thy ordinances"; "Not fearing Thee so as not to offend Thee". As a posthumous child perhaps Newton made God his father-figure in a more immediate sense than other young men might have been inclined to do. Certainly, Frank Manuel, author of a major psychological study of Newton, believed so. Newton, he suggested, "lived ever under the Taskmaster's eye", and that Taskmaster was not his own conscience (at least not as far as Newton was concerned) but God. Many years later, in the "General Scholium" written for the *Principia* in 1713, Newton told his readers about this taskmaster:

He rules all things, not as the world soul but as the lord of all. And because of his dominion he is called Lord God *Pantokrator*. For "god" is a relative word and has reference to servants, and godhood is the lordship of God, not over his own body as is supposed by those for whom God is the world soul, but over servants.¹⁸

Newton had already dismissed the need for a world soul, as an intermediary between God and the world, in *De gravitatione*:

the world is not to be called the creature of this soul but of God alone, who might create by establishing a soul of such nature that the world would arise

¹⁸ Newton's list of sins is in a notebook at Trinity College, MS R.4.48^c, quoted from Westfall, *Never at Rest*, p. 78. Newton, *The Principia*, p. 940. Frank E. Manuel, *The Religion of Isaac Newton* (Oxford: Clarendon Press, 1973), pp. 16-7; for his Freudian psychobiography of Newton see *A Portrait of Isaac Newton* (Cambridge, Mass.: Belknap Press of Harvard University, 1968).

necessarily. But I do not see why God himself does not immediately inform space with bodies.¹⁹

When Newton became a minor fellow of the “College of the Holy and Undivided Trinity”, to give it its full title, in October 1667, he had to swear:

that I will embrace the true religion of Christ with all my soul... and also that I will either set Theology as the object of my studies and will take holy orders when the time prescribed by these statutes arrives, or I will resign from the college.²⁰

Newton was not one to take an oath lightly. As the “time prescribed” (1675) drew nearer, therefore, he embarked upon serious study of the Holy Scriptures. It is hard to escape the conclusion that he wanted to be sure just what was the “true religion of Christ” that he had sworn to embrace. But, as Westfall has pointed out, there is no sign that Newton forced himself to undertake scriptural study as an unwelcome obligation. The extent of the papers he wrote, and the evident scholarship, both wide-ranging and meticulous, upon which they are based, reveal Newton's uncompromising commitment to what he believed was “no matter of indifference, but a duty of the greatest moment.”²¹

Dating the theological manuscripts with any certainty is in most cases impossible but it seems fairly clear that right from the beginning Newton became particularly concerned about the relationship of Christ to God, and the doctrine of the Trinity.

¹⁹ Hall and Hall, *Unpublished Scientific Papers*, pp. 142. It is possible that Newton had Henry More's “Spirit of Nature” in mind here, which More invoked as a vicegerent of God to preserve God's transcendence. Newton saw this, in *De gravitatione* and later (e.g. in the “General Scholium” of 1713), as a superfluous and empirically ungrounded conception.

²⁰ Trinity Statutes, quoted from Westfall, *Never at Rest*, p. 179.

²¹ Jewish National and University Library, Jerusalem, Yahuda MS 1.1, ff. 1-10. Westfall, *Never at Rest*, p. 310. Manuel, *Religion of Isaac Newton*, p. 109.

Once again, therefore, it was the nature of God, and divinity itself, which captured Newton's attention. Newton's God, the God of total dominion, as that term related to servants, was also "God of the Son".²² Christ was subordinate to God, a divine mediator between God and mankind, but a created being, *not* "consubstantial" with God Himself. Christ too was subject to the dominion of the supreme God. Newton's Biblical exegesis and historical scholarship on the early Christian Church led him to believe that the "true religion", of Apostolic Christianity, was the religion of the alleged heresiarch, Arius (*c.* 250 – *c.* 336), who had been condemned at the council of Nicaea in 325. Trinitarianism, introduced into Christian doctrine by Athanasius (*c.* 296 – 373), came to be seen by Newton as a pernicious form of idolatry, erroneously worshipping Christ as God.²³

If Antitrinitarianism was the major focus of Newton's early theological studies, he soon began to devote as much intellectual energy to interpreting apocalyptic prophecies. In one of his considerations of the subordination of Christ he had noted that "The Son acknowledgeth the original praescience of all future things to be in ye father onely."²⁴ This may have provided the original stimulus for Newton to consider the prophetic writings, but he would not have needed much encouragement. The troubled history of the Church in seventeenth century England, in the events leading up to the Civil Wars and throughout the subsequent Interregnum, led to a proliferation of prophetic exegesis. One of the leading figures in this movement was the Anglican

²² Cambridge University Library, Keynes MS 2, f. XII.

²³ It now seems clear that Newton was not merely an Arian, but that his heresy went much further, embracing other Antitrinitarian views, including those of the Socinians. See Stephen Snobelen, "Isaac Newton, Heretic: The Strategies of a Nicodemite". *The British Journal for the History of Science*, 32 (1999): 381-419; and idem, "Isaac Newton, Socinianism and 'the one supreme God'", in Martin Mulrow and Jan Rohls (eds), *Socinianism and Cultural Exchange: The European Dimension of Antitrinitarian and Arminian Networks, 1650-1720* (Leiden: Brill, 2005), pp. 241-293. Although drawing upon many earlier reformist traditions Newton essentially developed an eclectic system of religion, and heresy, of his own.

²⁴ Jewish National and University Library, Jerusalem, Yahuda MS 14, f. 25.

scholar, Josphe Mede, who dismissed allegorical interpretations of the Revelation of St John and insisted that the predictions, correctly interpreted, foretold a literal Kingdom of God on earth. Mede's ideas were taken up and extended by the Cambridge Platonist who was well known to Newton, Henry More. It is easy to see why Newton, already deeply immersed in Biblical exegesis, should turn to the prophetic books of Daniel and Revelation.²⁵

Mede and More both wrote in their prophetic writings of "the great apostasy", which they used as the starting point for the chronologies they unfolded. For them, the apostasy occurred when the Apostolic Church became the Roman Catholic Church, towards the end of the reign of the Emperor Theodosius (346–395). This date enabled them to suggest that the Anglican Church was the restored Apostolic Christian Church. For Newton, however, the Anglican Church was no less Trinitarian, and therefore idolatrous, than Catholicism, and so could not represent the Apostolic faith. For Newton, the great apostasy was Trinitarianism, which did not triumph in the Church, he believed, until about 607.²⁶ Unlike Mede and More, Newton saw nothing in his own times that looked even remotely like the true Church. Instead of using exegesis of the prophecies to establish the truth of Anglicanism, therefore, he used it to prove, once again, the dominion of God over mankind and its history. The "histories of things to come" which Newton saw written in the prophetic books, testified to God's control over the development of the Church and its peoples.²⁷

²⁵ For a general survey see Katherine R. Firth, *The Apocalyptic Tradition in Reformation Britain, 1530-1645* (Oxford: Oxford University Press, 1979).

²⁶ Jewish National and University Library, Jerusalem, Yahuda MS 1.2 ff. 60-1. See, Westfall, *Never at Rest*, pp. 320-9.

²⁷ Jewish National and University Library, Jerusalem, Yahuda MS 1.1a, f. 17r.

It is in this way that Newton's scriptural and historical studies relate to his work in natural theology. When the Anglican divine, Richard Bentley, wrote to Newton in 1692, to ask his advice on how to use the details of his natural philosophy to prove the existence of God, Newton was only too happy to oblige. Newton wrote back to say that "nothing can rejoice me more than to find it useful for that purpose." At the end of the same letter, however, he wrote:

There is yet another Argument for a Deity, which I take to be a very strong one, but till the Principles on which it is grounded are better received, I think it more advisable to let it sleep.²⁸

This is almost certainly a reference to Newton's work on the interpretation of prophecy. As Newton had written nearly twenty years before in his "Treatise on Revelation":

If then the Prophecies wch concerned the Apostolique age were given for ye conversion of ye men of that age to the truth & for the establishment of their faith, & if it was their duty to search diligently into those Prophecies: why should we not think that the Prophecies which concern the latter times into which we are fallen were in like manner intended for our use that in the midst of Apostacies we might be able to discern the truth & be established in the faith thereof, & consequently that it is also our duty to search with all diligence into these Prophecies.²⁹

The intention, then, was not to use the prophecies to make predictions, nor to try to guess the meaning of prophecies not yet fulfilled, but to show how what were once prophecies had by now come to pass. "The folly of Interpreters", according to Newton

²⁸ Newton, *Four Letters*, p. 11 (290).

²⁹ Jewish National and University Library, Jerusalem, Yahuda MS 1.1a, f. 2r-3r.

“has been, to foretel times and things by this Prophecy, as if God designed to make them Prophets”. The point of the prophecies, however, was “that after they were fulfilled they might be interpreted by the event, and his own Providence, not the Interpreters, be then manifested thereby to the world.”³⁰ The correlation between former prophecy and subsequent history can be used to demonstrate the true faith, and to guide the Church, by revealing God's Providence. There is a strict parallelism, therefore, between Newton's scriptural exegesis and his natural theology. Both are used to establish God's existence and His providential dominion over the world.

Alchemy, Active Principles, and Natural Theology

But during this time, while he was still a minor fellow at Trinity, approaching the time when he must become ordained or resign,³¹ Newton had also taken up his alchemical studies. Alchemy was not usually regarded as part of natural philosophy—certainly it was never taught in the universities as part of the natural philosophy curriculum—but it was generally assumed that its theories and practices were consistent with prevailing natural philosophical precepts.³² Most practitioners pursued alchemy in order to achieve its specific goals: transmutation of lead into gold, or creation of the philosopher's stone, or the alkahest, which were believed to enable either transmutation or the creation of a medicinal panacea. In Newton's case, however, alchemy can be seen as an empirical complement to the more speculative matter theory of the new mechanical philosophy. As Westfall, Rattansi and Dobbs have

³⁰ Isaac Newton, *Observations upon the Prophecies*, p. 251. This work was published posthumously, being compiled by its editor, Thomas Pellet, from two separate manuscripts, both written in Newton's old age. Although based on Newton's earlier views, they are sufficiently obscured that the work seems uncontroversial. See Westfall, *Never at Rest*, pp. 816-9.

³¹ In the event, Newton did not have to resign, nor swear to something in which he could not believe. He was preparing to resign his fellowship in Spring 1675 when a special dispensation from the Crown removed the requirement of ordination from all holders of the Lucasian professorship in mathematics. Newton had been appointed Lucasian professor in 1669. As always, the full story is told in Westfall, *Never at Rest*, pp. 330-4.

³² Dobbs, *Foundations*, pp. 43-7; Westfall, *Never at Rest*, pp. 18-23.

pointed out, Newton's alchemy seems to have been primarily concerned to discover and understand the active principles which he believed to reside in the particles of matter which were supposed, in the mechanical philosophy, to constitute all bodies.³³

It is not known when, or how, Newton arrived at his belief in active principles in matter, but their role in his natural philosophy, his optical theories, and his alchemy, is absolutely crucial and remained so from the beginning to the end of his career. As Westfall pointed out, "Newton's goal was to demonstrate the dependence of matter on God."³⁴ Empirically established active principles in matter serve not just a natural philosophical purpose, for Newton, but also a theological function. Since matter is, as Descartes supposed, passive and inert by its own nature, if it could be shown that matter was, in fact, endowed with principles of activity, such as gravitational attraction, this would constitute powerful evidence of God's existence. Active principles are not naturally or logically inherent in matter (the way, for example, extension is), so they can only have been implanted into matter by a supreme creator. Accordingly, in the "Queries" at the end of the *Opticks*, Newton repeatedly invoked these active principles:

It seems to me farther, that these Particles have not only a *Vis inertiae*,
accompanied with such passive Laws of Motion as naturally result from that

³³ R. S. Westfall, "Newton and the Hermetic Tradition", in Allen G. Debus (ed.), *Science, Medicine and Society in the Renaissance*, 2 vols (London: Heinemann, 1972), II, pp. 183-98; idem, *Never at Rest*, pp. 301-7, and "Newton and Alchemy", in Brian Vickers (ed.), *Occult and Scientific Mentalities in the Renaissance* (Cambridge: Cambridge University Press, 1984), pp. 315-35; P. M. Rattansi, "Newton's Alchemical Studies" in Debus (ed.), *Science, Medicine and Society in the Renaissance*, II, pp. 167-82; Dobbs, *Foundations of Newton's Alchemy*, idem, *Janus Faces of Genius*. See also Lawrence Principe, "Reflections on Newton's Alchemy in Light of the New Historiography of Alchemy", in James E. Force and Sarah Hutton (eds), *Newton and Newtonianism: New Studies* (Dordrecht: Kluwer Academic, 2004), pp. 205-20; William Newman, "The Background to Newton's Chymistry", and Karin Figala, "Newton's Alchemy", both in Cohen and Smith (eds), *Cambridge Companion to Newton*, pp. 358-69, and 370-86 respectively..

³⁴ Westfall, *Never at Rest*, p. 303.

Force, but also that they are moved by certain active Principles, such as is that of Gravity, and that which causes Fermentation, and the Cohesion of Bodies.³⁵

Newton insisted upon the reality of active principles not just in the *Opticks*, but throughout his career. They seem to first emerge in his alchemical writings. Indeed, it may be that Newton took up alchemy as a means of establishing the existence of active principles. The notion can clearly be seen in one of Newton's earliest alchemical writings, his study of the "Vegetation of metals", which may have been written as early as 1669. Having suggested that most, if not all, the mass of sensible matter "is nothing but AEther congealed & interwoven into various textures", Newton adds:

Note that tis more probable ye aether is but a vehicle to some more active spt. & ye bodys may bee concreted of both together, they may imbibe aether as well as air in generation & in yt aether ye spt is intangled. This spt perhaps is ye body of light 1 because both have a prodigious active principle both are perpetual workers 2 because all things may bee made to emit light by heat...³⁶

Generally speaking this short alchemical treatise is uncharacteristically obscure for Newton, but the fact that similar ideas appear in Newton's more public writings shows that these were ideas he took very seriously. There are echoes of Newton's

³⁵ Newton, *Opticks, or a Treatise of the Reflections, Refractions, Inflections and Colours of Light* (London, 1717), Query 31; I have used the Dover edition, based on the Fourth edition of 1730, New York: Dover Publications Inc., 1979, p. 401. On Newton's active principles see also J. E. McGuire, "Force, Active Principles and Newton's Invisible Realm", *Ambix*, 15 (1968): 154-208, reprinted in J. E. McGuire, *Tradition and Innovation: Newton's Metaphysics of Nature* (Dordrecht: Kluwer Academic, 1995), pp 190-238; and Alan Gabbey, "Newton, Active Powers, and the Mechanical Philosophy, in Cohen and Smith (eds), *Cambridge Companion to Newton*, pp. 329-57.

³⁶ Dibner MSS 1031 B (Burndy MS 16), ff. 3v-4r.

speculations in this alchemical work in his “Hypothesis Explaining the Properties of Light”, which he sent to be read at the Royal Society in 1675.

Perhaps the whole frame of nature [he wrote] may be nothing but various contextures of some certain aethereal spirits, or vapours, condensed as it were by precipitation, much after the manner, that vapours are condensed in water, or exhalations into grosser substances, though not so easily condensable; and after condensation wrought into various forms; at first by the immediate hand of the Creator; and ever since by the power of nature; which, by virtue of the command, increase and multiply, became a complete imitator of the copies set her by the protoplast. Thus perhaps may all things be originated from aether.

A little later, shortly after declaring nature to be “a perpetual worker”, Newton suggests that the aether may be imbibed by the sun, “to conserve his shining, and keep the planets from receding further from him”, and that it may be “the solary fewel and material principle of light”. Later still, we are told that “light and aether mutually act upon one another”.³⁷ Similar ideas about the nature of aether appear again in Newton's letter to Robert Boyle of February 1679, in the unfinished manuscript treatise entitled *De aere et aethere*, and in those “Queries” in the *Opticks* which consider the possibility of an all-pervasive universal aether.³⁸ Similar ideas to those in the “Vegetation of Metals” where light acts as an active principle, fuelling and driving the activity of matter, can be found throughout the rest of the “Queries”.

³⁷ Thomas Birch, *History of the Royal Society of London*, 4 vols (London, 1757), 3, pp. 250-1, 255. Reprinted in Cohen (ed.), *Isaac Newton's Papers and Letters*, pp. 180, 181, 185.

³⁸ Robert Boyle, *Works*, 5 vols (London, 1744), 1, pp. 70-3, reprinted in Cohen (ed.) *Isaac Newton's Papers and Letters*, pp. 250-54; Cambridge University Library, MS. Add. 3970, fols. 652-3, printed in Hall and Hall, *Unpublished Scientific Papers*, pp. 214-28; Newton, *Opticks* (London, 1717), Queries 17-24 (these queries were added into the sequence of queries in the 1717 edition), pp. 347-54.

We can see in the “Vegetation of Metals”, the “Hypothesis of Light” and other early speculations on the nature of aether and light, the beginnings of Newton's conviction that all physical phenomena can be explained in terms of attractive and repulsive forces residing in matter. To begin with, as is most clear in the letter to Boyle and in *De aere et aethere*, Newton seems to have thought only in terms of particles endowed with a “mutual force of repulsion”.³⁹ In so far as attractions between bodies are mentioned, as in the final sentence of *De aere et aethere*, the implication is that they can be explained in terms of the repulsive forces between particles of air or aether:

So also the attraction of glass, amber, jet, wax and resin and similar substances seems to be caused in the same way by a most tenuous matter of this kind.

When Newton wrote in the preface to the *Principia* that many things led him to suspect that all phenomena can be explained on the assumption that bodies “either are impelled toward one another... or are repelled from one another”, this idea of a balance of forces of attraction and repulsion, seems to have been something new.⁴⁰

It seems hard to escape the conclusion that the addition of attractive forces to the repulsive forces which Newton had been led to in his alchemical and optical research, only occurred to him after Robert Hooke suggested to him, in a letter of 1679, that an attractive force between the sun and the planets could account for Kepler's laws of planetary motions.⁴¹ In spite of the brilliance of earlier work in which Newton was able to show how the gravitation of the Moon towards the Earth and the gravitation of bodies at the surface of the Earth agreed “pretty nearly”, it seems clear that Newton was still thinking about the motions of the heavenly bodies, as did Descartes and other mechanical philosophers, as the result of a balance between forces inward and

³⁹ Hall and Hall, *Unpublished Scientific Papers*, pp. 225.

⁴⁰ Newton, *The Principia*, pp. 382-3.

⁴¹ See Westfall, *Never at Rest*, pp. 382-88

outward from their centres of revolution. Furthermore, in spite of considering repulsive actions at a distance in his alchemical work, he considered these cosmic forces in essentially Cartesian terms, regarding them as the result of pressures caused by the movements of bodies, with no consideration of actions between bodies at a distance.⁴² In the exchange of a few letters at the end of 1679 and the beginning of 1680, Hooke made it clear to Newton that Kepler's laws of planetary motion could be accounted for simply by assuming a single force of attraction (acting, as Hooke said, "in a duplicate proportion to the Distance from the Center Reciprocall") between the stationary Sun and a tangentially moving planet. As a result, as Westfall noted, when Newton came to write the *Principia* he "applied action at a distance to virtually all the phenomena of nature", whether cosmic or chemical.⁴³

Westfall suggested that Newton was confirmed by this correspondence with Hooke in his own earlier belief in "short-range attractions and repulsions", which Westfall suggested could be seen in *De aere et aethere*. But, in fact, there are no forces of attraction in *De aere et aethere*, nor in the closely associated letter to Robert Boyle, written in February 1679. In this letter Newton invokes repulsive forces between the particles of an aether and the particles of other bodies (which means that the ubiquitous aether will be "rarer" in the pores of bodies than "in free spaces") to account for, among other things, the cohesion of bodies. Clearly, the particles of bodies have no attractive powers by which they can cohere in the absence of aether. Similarly, the principle of sociability which Newton supposes between some liquors seems to act, in Newton's example, only by contact action, and "sociable" solvent spirits (we would say acids) which act upon metals can only "hitch themselves in by

⁴² Westfall, *Never at Rest*, pp. 147-52.

⁴³ Westfall, *Never at Rest*, p. 388.

degrees” between the particles of metal thanks to the “continual tremor the particles of metal are in”, again, there is no suggestion they can separate particles of metals by their powers of attraction.⁴⁴

It seems, therefore, that Hooke's role was crucial, enabling Newton to recognise the action of attractions, as well as repulsions, operating at a distance in the theatres of nature. In which case Hooke perhaps should be given more credit for his role in stimulating Newton's discovery of the universal principle of gravitation.⁴⁵

Hooke's importance has tended to be dismissed because of Newton's claim that he had already, as early as 1666, compared the force acting on the Moon, and keeping it in its orbit around the Earth, with the force acting on falling bodies near the Earth, and found these forces “to agree pretty nearly”. Westfall has suggested that the reason for the twenty-year delay between this early work on gravitation, during his so-called *annus mirabilis* of 1665-6, and the *Principia*, which he calls one of the persistent problems of Newtonian scholarship, was due to nothing more substantial than the contingent fact that Newton allowed himself to be completely preoccupied in the intervening period in alchemical and Scriptural research.⁴⁶ But, this is to give Newton too much credit, by implying that he had already arrived at the universal principle of gravitation long before Hooke wrote to him with the idea. It seems clear, however, that Newton was still thinking about gravity in Cartesian terms in 1666. Descartes explained the orbiting of the planets and the fall of bodies on Earth in terms of the

⁴⁴ Boyle, *Works*, I, pp. 70, 71-2, in Cohen (ed.) *Isaac Newton's Papers and Letters*, pp. 250, 251-2

⁴⁵ This seems to be happening at last. See, for example, Ofer Gal, *Meanest Foundations and Nobler Superstructures: Hooke, Newton and the “Compounding of the Celestial Motions of the Planets”* (Dordrecht: Kluwer Academic, 2002); and the Open Forum on “Newton vs. Hooke on Gravitation”, *Early Science and Medicine*, 10 (2005): 511-43.

⁴⁶ R. S. Westfall, “Newton's Theological Manuscripts”, in Zev Bechler (ed.), *Contemporary Newtonian Research* (D. Reidel, 1982), p. 131.

same general principles, namely the continuous descent of streams of particles pushing things towards a rotational centre (the Sun in the case of the planets, and the Earth in the case of everyday examples of falling bodies). In 1666 Newton was able to show that the inward force required to counteract the Moon's centrifugal force (due to its circular motion), and to keep the Moon in its orbit, and the inward force required to prevent bodies on the surface of a rotating Earth from flying off into the air, were close enough (by Newton's calculations) to suggest that Descartes was correct. The twenty year delay between this and the *Principia* occurred not because Newton was distracted by alchemy and religion, but simply because he believed in 1666 that all he had done was prove Descartes right, and there was no more to be said on the matter. It took the correspondence with Hooke in 1679 to alert him to the real importance of these calculations.

It is also clear, furthermore, that in 1666 Newton had not yet considered the possibility of actions at a distance operating in nature, and when he did think of them, as a result of his alchemical work, they were short-range forces of repulsion, not forces of attraction. It seems safe to conclude, therefore, that the "suspicion" he reported in the *Principia* of 1687, that all phenomena may depend upon forces of attraction and repulsion had only just recently occurred to him, and the correspondence with Hooke seems to have provided the occasion for it:

Many things lead me to have a suspicion that all phenomena may depend upon certain forces by which the particles of bodies, by causes not yet known, either are impelled toward one another and cohere in regular figures, or are repelled from one another and recede.

In the *Principia* itself, of course, he dealt only with attractive forces. But, as we've seen, there were "many things" which led him to believe in inter-particulate repulsive forces arising from his alchemical studies, and his early speculations on the natural philosophy of light. After the *Principia*, as we can see in *De natura acidorum*, written in 1692, both kinds of forces were invoked:

The particles of acids... are endowed with a great attractive force... the particles of salts... avoid each other and, by receding from one another as far as they can, are diffused throughout the whole water.⁴⁷

Newton's Voluntarist Theology

In view of the fact that active principles, such as attractive and repulsive forces, in matter were meant to prove the existence of God, Newton did not fail to mention Him in his early writings. What is significant, however, is that Newton was not content simply to affirm God's existence—he shows clear signs that he was concerned to affirm a particular kind of theology. For example, in the early alchemical work which we have already mentioned, the "Vegetation of Metals", Newton insisted that "The world might have been otherwise than it is", because it was created by God, by "a voluntary & free determination".⁴⁸ In statements like this, Newton announces that he subscribes to what is called voluntaristic theology, in which the emphasis is upon the absolute omnipotence of God, and his complete freedom in creating the world. The opposing theological position, embraced by Newton's great rival, G. W. Leibniz, is known as intellectualist, or necessitarian, theology, and took the line that God was

⁴⁷ Newton, *The Principia*, p. 382.

⁴⁸ John Henry, "Henry More versus Robert Boyle: The Spirit of Nature and the Nature of Providence", in Sarah Hutton (ed.), *Henry More (1614-1687): Tercentenary Studies* (Dordrecht: Kluwer Academic, 1990), pp. 55-76; H. G. Alexander (ed.), *The Leibniz-Clarke Correspondence* (Manchester: Manchester University Press, 1956); and Ezio Vailati, *Leibniz and Clarke: A Study of Their Correspondence* (Oxford: Oxford University Press, 1997).

constrained in the Creation of the world by certain absolute values—in particular, God was obliged by his supreme goodness to create the best of all possible worlds.

Perhaps the clearest examples of Newton's voluntaristic theology appear, as we have seen, in the early *De gravitatione et aequipondio fluidorum*, where he claims to “have deduced a description of this corporeal nature... so that God may appear... to have created the world solely by the act of will.”⁴⁹ Similarly, in his “Hypothesis of Light” Newton defended the notion that light may contain a principle of motion by affirming God's unrestricted omnipotence. “God, who gave animals self-motion beyond our understanding,” he wrote, “is, without doubt, able to implant other principles of motion in bodies, which we may understand as little.”⁵⁰ In *De aere et aethere* he suggested, as the cause of repulsion between particles of bodies, that “God may have created a certain incorporeal nature which seeks to repel bodies and make them less packed together.”⁵¹

So, we can see Newton's omnipotent “Lord God *Pantokrator*” behind his alchemy and his natural philosophy, no less than in his studies of Providential history and Biblical prophecy. The active principles are entirely necessary for the running of the world system:

For we meet with very little Motion in the World, besides what is owing to these active Principles. And if it were not for these Principles, the Bodies of the Earth, Comets, Sun, and all things in them, would grow cold and freeze, and become inactive Masses; and all Putrefaction, Generation, Vegetation, and

⁴⁹ Hall and Hall, *Unpublished Scientific Papers*, pp. 141.

⁵⁰ Birch, *History of the Royal Society*, 3, p. 256 (reprinted in Cohen, *Newton's Papers and Letters*, p. 186).

⁵¹ Hall and Hall, *Unpublished Scientific Papers*, pp. 223.

Life would cease, and the Planets and Comets would not remain in their Orbs.⁵²

These principles, therefore, act as God's servants, they are secondary causes which show his power and dominion over the world. "We know him only by His most wise and excellent contrivances of things and final causes," Newton wrote in the General Scholium, and went on to say that "a god without dominion, providence and final causes is nothing else but Fate and Nature", or "blind metaphysical necessity".

Newton believed he had made it plain that his God was not just blind necessity because he had demonstrated the existence of active principles which must have been added at the Creation to passive matter, and that, moreover, God had been perfectly free to create these or not.⁵³

The concern to show that not everything can be explained by "fate and Nature", or by "meer natural Causes", is prominent in Newton's clearest statements of natural theology, the letters he wrote to Richard Bentley in 1692 and 1693. In the first letter, for example, Newton admits that a universe like ours, with "an Infinite Number of great Masses" scattered throughout space, could have resulted perfectly naturally from initial conditions in which matter was evenly scattered throughout an infinite space, and every particle of matter had "an innate Gravity towards all the rest". Immediately, however, Newton points to something which cannot be explained naturally: "how the Matter should divide itself into two sorts", some forming large shining bodies, like the

⁵² Newton, *Opticks*, Query 31, pp. 399-400.

⁵³ Newton's commitment to a voluntarist theology has recently been challenged by Peter Harrison, "Was Newton a Voluntarist", in Force and Hutton (eds), *Newton and Newtonianism*, pp. 39-64. Harrison's claims demand a full examination, which I intend to provide elsewhere. In the meantime, the evidence presented here should serve to indicate the doubtfulness of his claims. It is significant, also, that Harrison never mentions the Leibniz-Clarke correspondence, the main site for an exposition of Newton's voluntarist theology. See, Alexander (ed.), *The Leibniz-Clarke Correspondence*, and Vailati, *Leibniz and Clarke*.

Sun and stars, others forming small opaque bodies, like the planets. This state of affairs, Newton insists, could not have emerged naturally from the presupposed initial conditions. There is only one reason for this sorting of matter into two kinds: “because the Author of the System thought it convenient”.⁵⁴

It is important to note, however, that Newton did not believe that God was directly responsible for making the large masses shine. Newton's God always did his bidding through servants, through secondary causes. Although he did not elaborate how God did this to Bentley, being content to show that it proved God's existence, he did explain it in secondary terms in the optical “Queries”. In “Query 11”, for example, Newton suggests that large bodies like the, Sun, once heated “beyond a certain degree” continue to “grow still hotter” by internal processes. But these internal processes, we learn in “Query 31”, are the result of “active principles”. It is due to the active principles, not God Himself, that “Bodies burn and shine,... and the Sun continues violently hot and lucid, and warms all things by his Light.”⁵⁵

The same point holds even with regard to the famous passage in the third letter where Newton denies “innate Gravity” in matter. This passage has caused some confusion among Newton scholars because it is easy to read it as a denial of the possibility of any physical cause operating at a distance, and therefore as a denial of gravitational attraction as a power in matter:

That one body may act upon another at a Distance thro' a Vacuum, without the Mediation of any thing else, by and through which their Action and Force may

⁵⁴ Newton, *Four Letters*, p. 4 (283). An entirely physical explanation for the fact that some of the matter in the universe shines brightly and gives off heat, while the rest does not, was provided by the Cartesian vortex system but Newton dismissed this.

⁵⁵ Newton, *Opticks*, Query 11, p. 343, and Query 31, p. 399.

be conveyed from one to another, is to me so great an Absurdity, that I believe no Man who has in philosophical Matters a competent Faculty of thinking, can ever fall into it.

But this reading forces the reader to conclude that the following comment must be a reference to God: "Gravity must be caused by an Agent acting constantly according to certain Laws".⁵⁶ However, this seems immediately dubious because Newton goes on to say that he remains undecided whether "this Agent be material or immaterial".

Newton was never in any doubt that God was immaterial, so he must have had something else in mind here.

In fact, as Emile Meyerson pointed out a long time ago, it is perfectly possible to read this passage in a different way.⁵⁷ On this alternative reading Newton's vigorously expressed objection is not to action at a distance (which elsewhere in his writings he readily accepts⁵⁸), but to the claim that matter can attract other matter by some innate power regarded as inherent in its very nature. By its nature, matter can affect other matter by contact, but it can only affect other matter "without mutual Contact" as a result of the "Mediation of something else, which is not material". Here we have a clear reference to God. Once again, Newton's point is that gravitational attraction cannot be explained mechanically, but must be the result of an active principle (it is this which he says might be either material or immaterial) and which can only have been endowed upon matter by an omnipotent God.⁵⁹

⁵⁶ Newton, *Four Letters*, pp. 25-6 (302-3). John Henry, "Isaac Newton y el problema de la acción a distancia", *Estudios de Filosofía*, 35 (2007): 189-226.

⁵⁷ Emile Meyerson, "Leibniz, Newton, and Action at a Distance", in idem, *Identity and Reality* (London: George Allen & Unwin Ltd., 1930), pp. 447-56, especially p. 453.

⁵⁸ Consider, for example, comments in the *Opticks*, Queries, 1, 21, 29, and 31, p. 339, p. 352, p. 371, p. 376 and 396.

⁵⁹ Confirmation of the accuracy of this reading can be seen from noting how Bentley himself interpreted Newton's words and put this argument to use in his Boyle Lectures. See, Richard Bentley, *A Confutation of Atheism from the Origin and Frame of the World* (London, 1693), Part II, pp. 28-30;

Throughout the letters to Bentley, then, Newton draws attention to aspects of the physical world which cannot be explained solely according to mechanical principles. The speeds, masses, and distances from the Sun of each of the planets are precisely the values required to keep the planets in stable orbits. This, and the fact that they move around the Sun in the same direction and in the same plane, proves that the cause of these things was “not blind and fortuitous, but very well skilled in Mechanics and Geometry.”⁶⁰

Isaac Newton, Deist?

It seems perfectly clear, then, that Newton's natural philosophy was, right from the outset, linked to a natural theology, a means of proving the existence and attributes of God by studying the details of the natural world. Issues arising from Newton's natural philosophy and theology may well have led Newton to study alchemy. If that is too speculative, we can be sure that his alchemy, however it was initiated, was immediately absorbed into the natural theological enterprise of understanding active principles in matter as evidence of God's dominion. When Newton began to study the history of the early church and its original theology, as the time drew near when he would be obliged to take Holy Orders to remain in his fellowship, he was soon attracted to interpretation of the prophetic writings. His aim, however, was not to become a prophet, but once again to be able to establish the power and dominion of God. The different facets of Newton's life's work were all driven by the same theological ambition.

reprinted in Newton, *Papers & Letters on Natural Philosophy*, pp. 340-2. See also, Meyerson, “Leibniz, Newton, and Action at a Distance”, p. 453; Henry, “Isaac Newton y el problema de la acción a distancia”, pp. 217-19.

⁶⁰ Newton, *Four Letters*, p. 8 (287).

What's more, ideas developed early in Newton's career continued to re-appear for the same purposes in later works. Ideas about the active principles of light and the aether in the "Vegetation of Metals" (1669?) re-appeared in the "Hypothesis of Light" (1675) and elsewhere, and were clearly used again for the "Queries" in the *Opticks* (1704, 1706 and 1717). A simple argument for God's existence in the early "Questiones" notebook, which pointed to the symmetry of the human body as evidence that it was carefully designed, was deployed once again in Query 31 of the *Opticks*, and in the section "Of Atheism" in the "Short Schem of the True Religion", written towards the end of his life.⁶¹ Ideas on God and His relationship to space first developed in *De gravitatione* (1668?) re-appeared in the important "General Scholium" added to the 1713 edition of the *Principia*. It is here, for example, that Newton tells us that God "by existing always and everywhere he constitutes duration and space", that He is "omnipresent not only virtually but also substantially", and echoing St Paul that "In him all things are contained and move".⁶²

The unity of purpose of Newton's writings is strongly supported by the fact that he occasionally alluded to his historical and scriptural research in his scientific writings. In particular Newton evidently could not refrain from alluding to conclusions he reached in a major and much re-worked, but again unfinished, work of historical theology entitled *Theologiae gentilis origines philosophicae* ["The Philosophical Origins of Gentile Theology"]. Based on Newton's conviction that idolatry was the

⁶¹ McGuire and Tamney, *Certain Philosophical Questions*, pp. 446-7; *Opticks*, Query 31, p. 402-3; Isaac Newton, *A Short Schem of the True Religion*, Keynes ms. 7, King's College, Cambridge, printed in I. B. Cohen and R. S. Westfall (eds), *Newton, Texts, Backgrounds, Commentaries* (New York: W. W. Norton, 1995), pp. 344-8, see p. 344.

⁶² "For in him we live, and move, and have our being", Acts, 17, 28. Newton, *The Principia*, p. 941.

fundamental sin, and that “the world loves to be deceived”,⁶³ Newton argued that the true worship was the worship of the one true God but that this had first been corrupted into idolatry after the death of Noah. All ancient peoples worshipped the same twelve gods under different names, Newton claimed, and although identified as their own kings or heroes, they derived from Noah and his sons and grandsons. God periodically tried to call people back to the true monotheistic religion, by sending prophets like Moses, and Jesus, but the majority always turned back to idolatry; even the Christian religion, by worshipping Christ as God in the Trinity became idolatrous. According to Newton's historical research into the origins of gentile theology, even Christianity “was not more true and did not become less corrupt” than other early religions.⁶⁴

Significantly, Newton believed that the theology of the Gentiles derived from “knowledge of the astronomy and physics of the system of the world.”⁶⁵ His evidence for this was based on claims that the most ancient form of worship took place in temples or “Prytanea” which imitated the system of nature, as the most fitting way to worship the God of nature:

The whole heavens they reckoned to be the true and real temple of God and therefore that a Prytaneum might deserve the name of his Temple they framed it so as in the fittest manner to represent the whole system of the heavens. A point of religion than which nothing can be more rational.

According to Newton's historical research, Temples in the original religion had a fire burning at their centres and were illuminated by six lamps, to represent the central Sun and the planets. While this form of temple originally helped worshippers to

⁶³ Jewish National and University Library, Jerusalem, Yahuda MS 1 (Ms. 1.1a), f. 5r.

⁶⁴ Jewish National and University Library, Jerusalem, Yahuda MS 16.2, f. 45r. See Westfall, *Never at Rest*, pp. 351-59.

⁶⁵ Yahuda MS 16.2, f. 1r.

“come to the knowledge of a Deity... by ye frame of nature”,⁶⁶ the corruption of religion led to a corruption of natural philosophy. Ptolemaic astronomy supplanted the Copernican astronomy of the old religion.

It seems very clear from this that Newton's attempts to discover the true religion led him to find in the ancient records a religion which was entirely based on natural theology—the belief that God could be discovered through his creation. Newton's natural philosophy and his Scriptural and historical studies both led him to conclude that God was best found in his Creation. If so far, in my talk, I have tended to emphasise the influence of Newton's theological concerns upon his natural philosophy, here we should be able to see that, ultimately, the influence went the other way: Newton's theology was shaped by his physics, and was based on reason, not revelation.

I agree, therefore, with the conclusion of R. S. Westfall, that, Newton was essentially a deist—one who is convinced that God must exist on rational grounds (chiefly the evidence provided by the natural world), but who does not accept the validity of so-called “revelation”. In supporting Westfall, I differ from other more recent commentators on Newton's religion such as James Force, Rob Iliffe and Stephen Snobelen, all of whom insist that the amount of time Newton devoted to studying the Bible shows that he was not a deist.⁶⁷ But, if Newton started off believing Scripture to

⁶⁶ Yahuda MS 17.3, f. 11r.

⁶⁷ Force, “Newton's God of Dominion”; Rob Iliffe, “‘Making a Shew’: Apocalyptic Hermeneutics and the Sociology of Christian Idolatry in the Work of Isaac Newton and Henry More”, in Force and Popkin (eds), *Books of Nature and Scripture*, pp. 55-88; Snobelen, “To Discourse of God”, and “Isaac Newton, Heretic”. Westfall first suggested that Newton's thought tended towards deism in his *Science and Religion in Seventeenth-Century England* (New Haven: Yale University Press, 1958), but see also, idem, “The Rise of Science and the Decline of Orthodox Christianity: A Study of Kepler, Descartes, and Newton”, in David C. Lindberg and Ronald L. Numbers (eds), *God and Nature: Historical Essays on the Encounter between Christianity and Science* (Berkeley: University of California Press, 1986),

be the direct word of God, by the time he came to write the *Origines* he saw the Old Testament merely as the historical records of the Jewish people, and no more authoritative than the historical records of other peoples that he consulted. Similarly, the New Testament consisted of records of the ministry of Jesus when he tried to turn men back to the true religion. For Newton the evangelists and Jesus himself were merely human: as Newton made clear in the “Twelve Articles” of religion, which he wrote towards the end of his life: “There is one God... and one Mediator between God and Man, the Man Christ Jesus.” So, although Newton undeniably spent huge amounts of time studying Scripture, he was not studying it as the revelation of God, but as the records of human historians. In this, therefore, he can be likened to Spinoza, and other early contributors to the belief that the Bible is history.

I have just quoted Newton as saying that there is only one mediator between God and man, namely Jesus Christ. But there are suggestions in Newton's work that he perhaps saw himself as someone whose duty it was to try to bring erring idolatrous Christians, back to the true faith, as Moses and Jesus had done before him. This seems to be suggested by the abbreviated allusions to his religious conclusions that he either made public, or nearly made public, in his printed works. After all, Newton's ideas were extremely heretical and could have led to him being charged with the capital offence of atheism, and yet he still planned to discuss this work in public on a number of occasions. For example, the opening paragraphs of the *System of the World* (1686, but not published until 1728), originally intended to be the final part of the *Principia*, to provide a non-mathematical summary of the conclusions arising from the mathematical part, suggest that many of the ancients knew the Copernican theory, and

pp. 218-37; and “Newton and Christianity”, in Frank T. Birtel (ed.), *Religion, Science and Public Policy* (New York: Crossroads, 1987), pp. 79-94, reprinted in I. B. Cohen and R. S. Westfall (eds), *Newton, Texts, Backgrounds, Commentaries* (New York: W. W. Norton, 1995), pp. 356-70.

link this to the religious rites of Vestal ceremonies, and the forms of their temples.⁶⁸

In the event Newton did not publish this attempt at a popularization of his physics, but he continued to think about publishing his researches into early cosmological theories.

The so-called "Classical Scholia", for example, were written for a projected second edition of the *Principia* in the 1690s which did not in fact appear. Although clearly not pursued with the same sense of importance as the religious histories, Newton gathered evidence here which could show, so he believed, that the Pythagoreans and other Ancient philosophers were aware of the universal principle of gravitation and its inverse square law of attraction.⁶⁹

In part, what Newton was doing in these projected scholia fits within a Renaissance tradition referred to by scholars as the *prisca scientia* tradition. Based on the belief that Adam had once known all things, and that wisdom decayed after the Fall, Renaissance intellectuals hoped to recover past knowledge, rather than to discover new knowledge.⁷⁰ This is why what we think of as the Copernican theory was more often than not referred to by its adherents as the *Pythagorean* theory. Scant ancient reports that Pythagoreans believed in the motion of the Earth were sufficient to establish the ancient pedigree of heliocentric astronomy, thereby increasing its credibility. If the theory could be found in the distant past, there was a possibility that

⁶⁸ Newton, *De mundi systemate* (London, 1728).

⁶⁹ For fuller considerations of the "Classical Scholia" see J. E. McGuire and P. M. Rattansi, "Newton y las 'flautas de Pan'", *Estudios de Filosofía*, 35 (2007): 149-87; and Paolo Casini, "Newton: the Classical Scholia". Both were written before Newton scholars became aware of the *Theologiae gentilis origines philosophicae* and therefore lack the vital perspective provided by that associated work, although McGuire and Rattansi seem (instinctively?) to relate the scholia to other drafts which draw directly upon the *Origines*. See, for example, "Newton y las 'flautas de Pan'", pp. 164-5. There is now a complete edition of these scholia: Volkmar Schöler, "Newton's *Scholia* from David Gregory's Estate on the Propositions IV through IX Book III of His *Principia*", in W. Lefevre (ed.), *Between Leibniz, Newton, and Kant* (Dordrecht: Kluwer Academic, 2001), pp. 213-65. And see also Ducheyne, "The General Scholium".

⁷⁰ For a consideration of this tradition see D. P. Walker, *The Ancient Theology* (London: Duckworth, 1972).

it was part of Adamic wisdom.⁷¹ Conversely, any new theory which failed to establish ancient antecedents seemed far less likely to be true.

Newton's "Classical Scholia" were intended to take this tradition further. The aim was not just to provide corroboration of Newton's universal principle of gravitation, which (given its mathematical success) hardly needed it anyway, but to show how these ideas about cosmology were linked to ancient religious beliefs based on a true understanding of the God of nature:

And to the mystical philosophers Pan was the supreme divinity inspiring this world with harmonic ratio like a musical instrument and handling it with modulation, according to that saying of Orpheus "striking the harmony of the world in playful song". Thence they named harmony God and soul of the world composed of harmonic numbers. But they said that the Planets move in their circuits by force of their own souls, that is, by the force of the gravity which takes its origin from the action of the soul. From this, it seems, arose the opinion of the Peripatetics concerning Intelligences moving solid globes. But the souls of the Sun and of all the Planets the more ancient philosophers held for one and the same divinity exercising its powers in all bodies whatsoever, according to that of Orpheus in the Bowl.⁷²

Needless to say, for Newton the belief of the more ancient philosophers, rather than that of the Peripatetics was closer to the truth. The one God exercised His dominion in all bodies, by imposing upon them the active principle of gravitational attraction.

⁷¹ Copernicus himself, of course, sought to find such Ancient pedigrees for his theory. He discusses them in the preface to Pope Paul III of his *De revolutionibus orbium coelestium* (Nuremberg, 1543).

⁷² Royal Society, Gregory MS 247, f. 13r.

The “Classical Scholia” should be seen, therefore, as further attempts by Newton to understand the history of the original faith before it was corrupted by idolatry, or as it was temporarily recaptured by subsequent thinkers, and to show the close relationship between the true faith on the one hand, and the true (Newtonian) natural philosophy and natural theology on the other.

Allusions to Newton's understanding of the historical vicissitudes of the true faith, as developed in the *Theologiae gentilis origines philosophicae*, appear time and again in his works. It appears in the “Short Schem of the True Religion”, for example, where we are told of “the religion of the first ages till they forsook the right worship of the true God” and “corrupted themselves” by turning to idolatry and immorality.

But, much more significantly, these ideas also appeared publicly in the closing words of the *Opticks*. The “Queries” at the end of the *Opticks*, therefore, can be seen to bring together all aspects of Newton's work. There are echoes here of the “Hypothesis of Light” and the alchemical cosmology upon which it is based, which was outlined in the “Vegetation of Metals”.⁷³ More than anywhere else in his work the Newtonian concept of “active principles” is fully articulated. In particular, it was in the “Queries” that Newton filled out his hint in the *Principia* preface that all natural phenomena might be explained by attractive and repulsive forces between the particles of matter.⁷⁴ In some of the queries, added to the 1717 edition and numbered 17 to 24, he revived explanations, based solely upon an aether consisting of particles endowed with repulsive forces, which he had hinted at in *De gravitatione* and developed in *De*

⁷³ Newton, *Opticks*, Queries 5, 21, 30, and 31, p. 339, p. 352, p. 374, p. 405.

⁷⁴ Newton, *Opticks*, Query 31, p. 387-9, 394-7, 399-402.

aere et aethere, and elsewhere.⁷⁵ Moreover, he made it perfectly explicit just how these ideas of active principles related to God and his omnipotent and arbitrary will, repeating natural theological arguments which he had developed in *De gravitatione* and his letters to Bentley.⁷⁶ He even alludes to the material in the unpublished "Classical Scholia".⁷⁷ Finally, in the closing words, he explicitly draws upon the history of the true religion which he had begun to develop in the *Origines*.

It is in this remarkable closing passage of the *Opticks*, therefore, that we can see how Newton refused to distinguish the different parts of his enterprise. Natural philosophy does not just lead to natural theology, Newton implies, but to an improved sense of morality, and perhaps, even to another revival of the true religion which had flourished before Noah and his sons.

And if natural philosophy in all its Parts, by pursuing this Method, shall at length be perfected, the bounds of Moral Philosophy will be also enlarged. For so far as we can know by natural philosophy what is the first Cause, what Power he has over us, and what Benefits we receive from him, so far our Duty towards him, as well as that towards one another, will appear to us by the light of Nature. And no doubt, if the Worship of false Gods had not blinded the Heathen, their moral Philosophy would have gone farther than to the four Cardinal Virtues; and instead of teaching the Transmigration of Souls, and to worship the Sun and Moon, and dead Heroes, they would have taught us to

⁷⁵ Newton, *Opticks*, Queries 17 to 24, pp. 347-54.

⁷⁶ Newton, *Opticks*, Queries 29, 31, pp. 369, 400, 402, 403-4.

⁷⁷ Newton, *Opticks*, Query 28, p. 369.

worship our true Author and Benefactor, as their Ancestors did under the government of Noah and his Sons before they corrupted themselves.⁷⁸

John Henry
University of Edinburgh
Science Studies Unit
Chisholm House
High School Yards
Edinburgh EH1 1LZ
Scotland

⁷⁸ Newton, *Opticks*, Query 31, pp. 405-6. Compare with the opening words of *A Short Schem of the True Religion*, and its final section, "Of Humanity", in Cohen and Westfall (eds), *Newton, Texts, Backgrounds, Commentaries*, p. 344, and pp. 347-8.